

Serum myoglobin after cardiac catheterisation

J M McCOMB, E A McMASTER

From the Regional Medical Cardiology Centre, Royal Victoria Hospital, Belfast, Northern Ireland

SUMMARY Study of 80 consecutive patients undergoing elective diagnostic cardiac catheterisation showed that after the procedure 25 (31%) developed myoglobinaemia. This was attributed to complications of the catheterisation in two. The remaining 23 had received premedication by intramuscular injection. In patients without intramuscular injections myoglobinaemia did not occur after uncomplicated cardiac catheterisation.

The study did not support the proposition that cardiac catheterisation results in myocardial damage which can be detected by abnormalities of myoglobin but not by conventional indications of myocardial necrosis.

Cardiac catheterisation,¹ and in particular coronary arteriography,² have a significant morbidity and mortality; myocardial infarction occurs in a small proportion of patients^{3,4} and angina pectoris in a further number.⁵ Urinary myoglobin has been measured after routine cardiac catheterisation using an indirect haemagglutination method;⁶ it was detected in 39 (27%) of 146 patients.⁶ This was attributed to transient and perhaps reversible myocardial injury. All the 146 patients had received premedication by intramuscular injection.

Excretion of myoglobin in the urine was first described after extensive skeletal muscle injury.⁷ It has since been found to be a reliable indicator of myocardial infarction.^{8,9} Myoglobinaemia has been regarded as a similar indicator.¹⁰ Abnormal amounts of myoglobin in the urine and the serum, however, do not specifically indicate cardiac necrosis, as myoglobin in skeletal muscle is immunologically indistinct from that in the myocardium.¹¹ Skeletal muscle trauma causes both myoglobinuria and myoglobinaemia.^{12,13} It is not clear whether intramuscular injections cause sufficient skeletal muscle trauma to raise the serum myoglobin.¹⁴⁻¹⁶

In a preliminary study of 35 patients undergoing cardiac catheterisation, myoglobinaemia was detected in nine. It did not occur, however, after uncomplicated cardiac catheterisation in patients who had not had intramuscular injections. A randomised controlled study of 80 consecutive patients was carried out to investigate further the occurrence of myoglobinaemia after cardiac catheterisation.

Patients and methods

Eighty consecutive patients undergoing elective cardiac catheterisation were studied. The patients were randomised into two groups, so that half received premedication orally, and half by intramuscular injection. The premedicant drug was determined by the physician undertaking the catheterisation. Most patients received 10 mg diazepam (Valium). Some were given 50 mg pethidine and 25 mg promethazine (Phenergan). One received 25 mg pethidine, 6.25 mg chlorpromazine, and 6.25 mg promethazine. Premedication was given one hour before the catheterisation was started.

A venous blood sample was obtained before the administration of the premedication and one, four, eight, and 24 hours after it. Serum creatine kinase was measured in all samples, using an automated method. Serum myoglobin was measured in all samples by radioimmunoassay. Serum aspartate transaminase, lactic dehydrogenase, and blood urea were measured in the first and last samples.

Electrocardiograms were recorded before and after the catheterisation. The contrast medium used in all cases was Urografin 370 (meglumine diatrizoate and sodium diatrizoate). The volume of contrast used and the image intensification screening time required to complete the investigation were recorded.

Any complications that developed during or after the catheterisation were recorded.

DIAGNOSIS AND COMPLICATIONS

Twenty-seven patients underwent left and right heart catheterisation only, 10 right and left heart catheter-

isation with coronary arteriography, 37 left ventriculography and coronary arteriography, and six left ventriculography only.

Thirty-two patients were found to have coronary artery disease, 32 had acquired valvular heart disease, nine had congenital heart disease, two had hypertrophic obstructive cardiomyopathy, and in five no abnormality was detected.

Five patients developed angina pectoris during coronary arteriography, which was short lasting. One patient developed ventricular fibrillation during arteriography, from which he was rapidly resuscitated. Another patient developed acute obstruction of the left ventricular outflow tract eight hours after catheterisation, and ventricular fibrillation an hour later, from which she was resuscitated.

Results

Twenty-five (31%) of the 80 patients developed myoglobinaemia (>85 ng/100 ml) after cardiac catheterisation. Ten of these had coronary artery disease.

There was no significant association between myoglobinaemia and age, weight, screening time, volume of contrast medium injected, premedicant drug given, performance of a coronary arteriogram, or final diagnosis.

Twenty-three of the 25 patients who developed a raised serum myoglobin after the procedure had had premedication by intramuscular injection. This was very highly significant ($p < 0.001$). The remaining two patients both orally premedicated had been resuscitated from ventricular fibrillation (Table).

The serum myoglobin was normal in the 23 patients initially. It was raised in 14 (>85 ng/ml) one hour after premedication, before the start of the catheterisation. Four hours after premedication the serum myoglobin was raised in 19. It had returned to normal 24 hours after catheterisation in all.

The distribution of the mean serum myoglobin measurements in those who had received oral premedication is compared in the Figure with that in the patients given premedication by intramuscular injection.

Twenty-three (57.5%) of the 40 patients who had

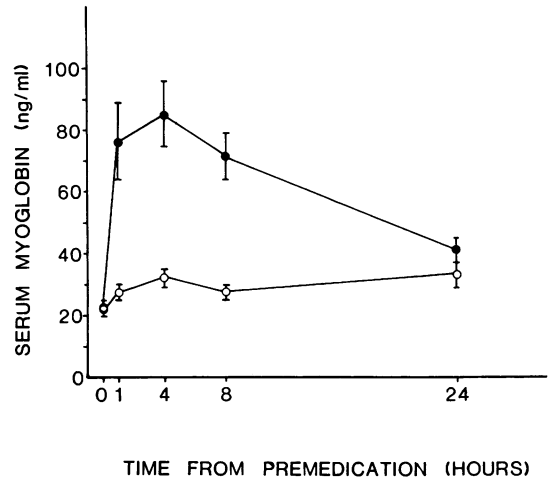


Fig. Mean (\pm SD) serum myoglobin measurements in relation to catheterisation. Premedication: \circ oral; \bullet intramuscular.

received an intramuscular injection developed myoglobinaemia. None of the 38 patients who had oral premedication and an uncomplicated catheterisation developed myoglobinaemia.

The serum creatine kinase was abnormal in 20 of the 23 patients who developed myoglobinaemia after intramuscular injection, and in both the patients resuscitated from ventricular fibrillation. It was normal in the remaining patients.

Discussion

Twenty-five (31%) of 80 patients developed a raised serum myoglobin after cardiac catheterisation. Two of these had ventricular fibrillation. The development of myoglobinaemia may have been related to resuscitation. The remaining 23 had had an intramuscular injection. None of the 38 patients who had oral premedication, and who had an uncomplicated catheterisation, developed myoglobinaemia. It was concluded that intramuscular injection of the premedication was the cause of myoglobinaemia in these patients.

No significant relation was seen between myoglobinaemia, the type of procedure undertaken, the screening time required, or the volume of contrast medium injected, all of which might indicate the "severity of the procedure". Nor was there a significant relation with the age, sex, or weight of the patient.

Increase in the serum creatine kinase after cardiac catheterisation was at first attributed to cardiac trauma.^{17,18} The finding of an increase in serum creatine kinase, however, was not consistently reported,¹⁹ and it became clear that the observed rise

Table Serum myoglobin in relation to route of premedication

Serum myoglobin	Premedication	
	Oral	Intramuscular
Raised >85 ng/ml	2*	23
Normal	38	17

$\chi^2 = 25.658$.

$p < 0.001$.

*Ventricular fibrillation.

in serum creatine kinase after cardiac catheterisation, in the absence of complications, was the result of skeletal muscle trauma, resulting from intramuscular injection.²⁰⁻²³ Intramuscular injection can cause an increase in the serum creatine kinase.^{24 25} The enzyme rise also depends on the agent injected as injections of physiological saline do not increase the serum creatine kinase.^{26 27}

The serum myoglobin appears to be similarly affected by intramuscular injection. Normal serum myoglobin levels have been reported after intramuscular injection of physiological saline.^{28 29} Raised serum myoglobin levels have been found in patients receiving daily intramuscular penicillin.³⁰

There have been similarly variable reports about the serum myoglobin after cardiac catheterisation. Stone *et al.*¹⁵ reported nine patients who had left ventriculography and coronary arteriography. The serum myoglobin was normal in all before the catheterisation, and in none did it rise outside the normal range in the 24 hours after catheterisation.

This study confirms the development of myoglobinaemia after elective cardiac catheterisation. It attributes the increase in serum myoglobin to the use of intramuscular injections of drugs as premedication, and refutes the proposition that abnormalities in myoglobin after cardiac catheterisation indicate myocardial necrosis.⁶

We thank the Research Committee, Royal Victoria Hospital, Belfast, who funded this study; we also thank Mr D W Neill, Biochemistry Department, Royal Victoria Hospital, for his help.

References

- Braunwald E, Gorlin R. Total population studied, procedures employed, and incidence of complications. *Circulation* 1968; **37** & **38**, suppl III: 8-16.
- Anonymous. Risks of coronary arteriography (Editorial). *Br Med J* 1980; **281**: 627-8.
- Bourassa MG, Noble J. Complication rate of coronary arteriography. A review of 5250 cases studied by a percutaneous femoral technique. *Circulation* 1976; **53**: 106-14.
- Adams DF, Fraser DB, Abrams HL. The complications of coronary arteriography. *Circulation* 1973; **48**: 609-18.
- Pridie RB, Booth E, Fawzey E, *et al.* Coronary angiography: review of 1500 consecutive cases. *Br Heart J* 1978; **38**: 1200-3.
- Donald TG, Cloonan MJ, Wilcken DEL. Excretion of myoglobin in urine after cardiac catheterisation. *Br Heart J* 1978; **40**: 1237-42.
- Bywaters EGL, Beall D. Crush injuries with impairment of renal function. *Br Med J* 1941; **i**: 427-32.
- Levine RS, Alterman M, Gubner RS, Adams EC Jr. Myoglobinuria in myocardial infarction. *Am J Med Sci* 1971; **262**: 179-83.
- Donald TG, Cloonan MJ, Neale C, Wilcken DEL. Excretion of myoglobin in urine after acute myocardial infarction. *Br Heart J* 1977; **39**: 29-34.
- Stone MJ, Willerson JT, Gomez-Sanchez CE, Waterman MR. Radioimmunoassay of myoglobin in human serum. Results in patients with acute myocardial infarction. *J Clin Invest* 1975; **56**: 1334-9.
- Kagen LJ. *Myoglobin: biochemical, physiological and clinical aspects*. New York & London: Columbia University Press, 1973.
- Rowland LP, Penn AS. Myoglobinuria. *Med Clin North Am* 1972; **56**: 1233-56.
- Klocke FJ, Visco JP, Reichlin M. Myoglobinemia as an index of myocardial infarction and/or ischemia (abstract). *Circulation* 1976; **53** & **54**, suppl II: 29.
- Jutzky RV, Nevatt GW, Palmer FJ, Nelson JC. Radioimmunoassay of serum myoglobin in acute myocardial infarction (abstract). *Am J Cardiol* 1976; **35**: 147.
- Stone MJ, Waterman MR, Willson NR, *et al.* Radioimmunoassay of serum myoglobin in the diagnosis of acute myocardial infarction in patients (abstract). *Circulation* 1976; **53** & **54**, suppl II: 29.
- Varki AP, Roby DS, Watts H, Zatuchni J. Serum myoglobin in acute myocardial infarction. A clinical study and review of the literature. *Am Heart J* 1978; **96**: 680-8.
- Marpole D, Judkins M, Kloster F, Marquardt V, Griswold H. Elevated serum enzymes following coronary angiography (abstract). *Circulation* 1968; **37** & **38**, suppl VI: 134.
- Michie DD, Conley MA, Carretta RF, Booth RW. Serum enzyme changes following cardiac catheterizations with and without selective coronary arteriography. *Am J Med Sci* 1970; **260**: 11-20.
- Burckhardt D, Vera CA, La Due JS, Steinberg I. Enzyme activity following angiography. *AJR* 1968; **102**: 446-50.
- Wolfe RR, Ruttenberg HD, Moss AJ. Serum creatine phosphokinase levels in children undergoing cardiac catheterization. *J Pediatr* 1970; **77**: 52-8.
- Harrison DC, Matloff HJ, Wexler L. Serum enzymes following coronary and other forms of cardiac angiography (abstract). *Circulation* 1972; **45** & **46**, suppl II: 21.
- Chahine RA, Eber LM, Kattus AA. Interpretation of the serum enzyme changes following cardiac catheterization and coronary angiography. *Am Heart J* 1974; **87**: 170-4.
- Roberts R, Ludbrook PA, Weiss ES, Sobel BE. Serum CPK isoenzymes after cardiac catheterisation. *Br Heart J* 1975; **37**: 1144-9.
- Hess JW, MacDonald RP, Frederick RJ, Jones RN, Neely J, Gross D. Serum creatine phosphokinase (CPK) activity in disorders of heart and skeletal muscle. *Ann Intern Med* 1964; **61**: 1015-28.
- Warnock DG, Ellman GL. Intramuscular chlorpromazine and creatine kinase: acute psychoses or local muscle trauma? *Science* 1969; **164**: 726.
- Meltzer HY, Mrozak S, Boyer M. Effect of intramuscular injections on serum creatine phosphokinase activity. *Am J Med Sci* 1970; **259**: 42-8.

- 27 Kuster J. Increased creatine-kinase concentrations after intramuscular injection of diazepam. *German Medicine* 1972; 2: 154-5.
- 28 Jutzy RV, Nelson JC, Lewis JE. Myoglobinemia in conditions other than myocardial infarction (abstract). *Circulation* 1976; 53 & 54, suppl II: 29.
- 29 Miyoshi K, Saito S, Kawai H, *et al.* Radioimmunoassay for human myoglobin: methods and results in patients with skeletal muscle or myocardial disorders. *J Lab Clin Med* 1978; 92: 341-52.
- 30 Hansen KN, Lindo KE, Ludvigsen CV, Norgaard-Petersen B. Serum myoglobin compared with creatine kinase in patients with acute myocardial infarction. *Acta Med Scand* 1980; 207: 265-70.

Requests for reprints to Dr J M McComb, Regional Medical Cardiology Centre, Royal Victoria Hospital, Belfast BT12 6BA, Northern Ireland.